DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. The amendment of June 10, 2009 has been received and entered. With the entry of the amendment, claims 1-8, 12 and 19 are canceled, and claims 9-11, 13-18 and 20-22 are pending for examination.

Terminal Disclaimer

2. The terminal disclaimer filed on December 12, 2008 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of any patent granted on application number 11/739,575 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the

various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. The rejection of claims 9-11, 14-18 and 20-22 under 35 U.S.C. 103(a) as being unpatentable over Schneble, Jr. et al (US 3628999) in view of Locke et al (US 5425751) is withdrawn due to the amendments of June 10, 2009 changing the scope of the claims.

6. Claims 9 and 13-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan 04-206875 (hereinafter '875) in view of Amano (US 5289038).

'875 teaches that it is well known to provide a metal filling method for semiconductor elements, where a semiconductor substrate such as GaAs is provided and non-through hole is formed with extends from a first surface towards an opposite surface of a substrate. See figure 1(c), pages 1, 5 of translation (hole 4). A metal layer is formed on an inner peripheral surface portion of the non-through hole adjacent to the first surface of the substrate, and on the portion of the first surface of the substrate adjacent to the non-through hole. Figure 1(d), pages 1, 4 of translation (Ti/Au film 6 formed on the hole 4 and around the hole 4). Then the non-through hole is filled with

molten metal and the molten metal is allowed to solidify. Figure 1 (e), (f) and page 5 of translation (softened gold 7 would be at least suggested to be molten, because it must be in a condition of being softened by heat as opposed to solidified, and softened would be inclusive of molten). Then part of the substrate is removed such that the solidified metal is exposed through the opposite surface of the substrate. Figure 1(h) and page 5 of translation.

Claim 13: part of the substrate is removed by polishing. Page 1 of translation ("processed by polishing").

Claim 14: the solidified metal comprises an external section which protrudes from the first surface of the substrate. Figure 1(g).

Claim 15: the external section comprises a bump. Figure 1(g).

'875 provides all the features of these claims except that before forming the inner layer an oxide layer is formed on an inner peripheral surface portion of the non-through hole adjacent to the first surface of the substrate and on a portion of the first surface of the substrate adjacent to the non-through hole, such that only the oxide layer is layered on the substrate.

However, Amano teaches that when providing semiconductor substrates with non-through holes to which metal filling is provided, it is well known to provide a first layer of oxide (insulation film 22 of silica) directly on the substrate in the hole (concave) are and on a portion of the substrate adjacent this area. Figure 2 and column 4, line 40 through column 5, lines 35. Then a metal film 23 is provided directly on the insulation

film 22 in the hole (concave) area and a portion of film 22 adjacent the hole area. Column 5, lines 25-35 and figure 2. Then, over that area the metal filling area 26 is provided. Column 5, lines 5-15.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 to provide an oxide insulation film in the through hole and adjacent the through hole, directly on the substrate and under the area where the metal layer is provided as suggested by Amano with an expectation of providing a desirable insulation between the semiconductor substrate and the metal layer as '875 teaches providing a metal layer between a semiconductor substrate and filled metal of a hole area and Amano teaches that when providing a metal layer between a semiconductor substrate and filled metal of a hole area it is well known to further provide an oxide insulation layer between the semiconductor substrate and the metal layer.

7. Claims 10-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over '875 in view of Amano as applied to claims 9 and 13-15 above, and further in view of Schneble, Jr. et al (US 3628999).

'875 in view of Amano teaches all the features of these claims except filling the non-through hole by immersing the substrate in a molten metal (claim 10) and then solidifying the metal by discharging the substrate from the molten metal (claim 11).

However, Schneble teaches a metal filling method. Column 4, lines 40-75. A hole is formed in a work piece extending from a first surface towards and opposite surface of a work piece. Column 4, lines 55-60 (holes 28) and figure 1E. The hole extends "into" base 10, and is not required to pass entirely through the substrate (base). Column 4, lines 55-50 and Figure 1. Then a metal layer is formed on at least an inner surface of one end of the hole adjacent the first surface of the work piece. Column 4, lines 55-65 (deposit 30) and figure 1F. The metal layer is also formed on a portion of the first surface of the work piece adjacent the hole, and thus is directly adhered to the first surface of the work piece adjacent the hole. Column 4, lines 60-70, column 5, lines 5-15 and figure 1F (land 32 on the top of mask layer 26 of the work piece, note that the hole is formed in a "work piece" that has base 10 and layers 22, 24, 26 as shown in figure 1E, and thus the top of mask layer 26 is the "first surface" of the work piece; to which the metal layer is directly adhered to (stuck fast or attached) until the layer 26 is actually removed as in figure 1G, column 4, lines 65-70). Then a third step of filling a molten metal into the fine hole is provided. Column 4, lines 65-75, column 5, lines 25-30 (solder would be metal) and Figure 1H (see 34). These form conductive passageways (connectors). Column 2, lines 40-50. The hole is filled by immersing the work piece in molten metal. Column 2, lines 1-10, column 4, lines 65-75, column 5, lines 20-60 (dipping in a molten solder bath). The solder metal comprises an external section which protrudes from the first surface of the work piece, forming a "bump" shape. Figure 1H and column 4, lines 70-75.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 in view of Amano to provide the metal filling method by immersing the work piece in molten metal as suggested by Schneble with an expectation of desirable metal filling results, because '875 in view of Amano provides filling metal in a non-through hole after the hole area has an oxide layer followed by a metal layer; and Schneble provides a known way to fill a non-through hole with a metal layer on the inside with a metal fill. It would further have been obvious '875 in view of Amano and Schneble to further remove the work piece from the molten metal bath and solidify the molten metal, in order to have a desirable treated substrate for use, because '875 in view of Amano and Schneble teaches to dip the article in molten metal, and demonstrates the result of a plated and filled article, indicating that the article must be removed from the molten metal bath for final use and furthermore the molten metal would solidify after removed from the bath, because it was no longer heated.

8. Claims 16 and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over '875 in view of Amano as applied to claims 9 and 13-15 above, and further in view of Locke et al (US 5245751).

'875 in view of Amano teaches all the features of these claims except (1) that the hole is a through hole that extends through the work piece (claim 16) and that the metal filling method further comprises closing the opening of the through holes and then

opening the closed opening (claim 16), (2) and the closing of the opening using sealing material (claim 20).

Locke teaches that it is well known to provide connector through holes in an article where the holes are to be filled with metal. Column 4, lines 5-20. Locke teaches that it is known to form the connectors by providing a via or hole 82 that extends partially into a substrate (layer 80) of a work piece. Figure 6a and column 8, lines 20-30. Then the hole is plated to fill with conductor metals. Figure 6b and column 8, lines 25-35. Then the substrate 80 is partially removed to expose the metal in the hole by a process such as etching. Figure 6c and column 8, lines 35-40. Solder can be plated into the holes. Column 8, lines 40-45. Locke also teaches that it is known to form the connectors by providing a through hole 58 through a substrate (sheet 56) and to close/block/seal the hole using a layer 54 (copper foil). Figure 5a and column 7, lines 40-47. Then the hole is plated to fill with conductor metals. Column 7, lines 45-55 and figure 5b. Then the layer 54 is removed to expose the metal through the opening of the through hole. Figure 5c and column 7, lines 54-60.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 in view of Amano to provide a through hole that extends through the entire work piece but is blocked by a sealing layer (closing one side of the opening) to allow desirable filling and then to open the closed opening by removing the sealing layer as suggested by Locke in order to provide desirable connectors, because '875 in view of Amano teaches to provide holes into the substrate to

be filled with metal and that the holes will become through holes and Locke teaches that when providing connector holes, it is known to provide them as a through hole that extends through the entire work piece but is blocked by a sealing layer (closing one side of the opening) to allow desirable filling, and then to open the closed opening by removing the sealing layer, which would provided an equivalent through hole system result to that provided by '875 in view of Amano. It would have been obvious to that the sealing layer would be provided either before or after hole formation with an expectation of equivalent results as long as it was provided before the filling of the holes, because the purpose of the sealing layer is to block the opening during filling. Also note In re Burhans, 154 F.2d 690, 69 USPQ 330 (CCPA 1946) (selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results) (MPEP 2144.04. IV. C).

9. Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over '875 in view of Amano and Locke as applied to claims 16 and 20-22 above, and further in view of Schneble, Jr. et al (US 3628999).

'875 in view of Amano and Locke teaches all the features of these claims except filling the non-through hole by immersing the substrate in a molten metal (claim 17) and then solidifying the metal by discharging the substrate from the molten metal (claim 18).

However, Schneble teaches a metal filling method. Column 4, lines 40-75. A hole is formed in a work piece extending from a first surface towards and opposite surface of a work piece. Column 4, lines 55-60 (holes 28) and figure 1E. The hole extends "into" base 10, and is not required to pass entirely through the substrate (base). Column 4, lines 55-50 and Figure 1. Then a metal layer is formed on at least an inner surface of one end of the hole adjacent the first surface of the work piece. Column 4, lines 55-65 (deposit 30) and figure 1F. The metal layer is also formed on a portion of the first surface of the work piece adjacent the hole, and thus is directly adhered to the first surface of the work piece adjacent the hole. Column 4, lines 60-70, column 5, lines 5-15 and figure 1F (land 32 on the top of mask layer 26 of the work piece, note that the hole is formed in a "work piece" that has base 10 and layers 22, 24, 26 as shown in figure 1E, and thus the top of mask layer 26 is the "first surface" of the work piece; to which the metal layer is directly adhered to (stuck fast or attached) until the layer 26 is actually removed as in figure 1G, column 4, lines 65-70). Then a third step of filling a molten metal into the fine hole is provided. Column 4, lines 65-75, column 5, lines 25-30 (solder would be metal) and Figure 1H (see 34). These form conductive passageways (connectors). Column 2, lines 40-50. The hole is filled by immersing the work piece in molten metal. Column 2, lines 1-10, column 4, lines 65-75, column 5, lines 20-60 (dipping in a molten solder bath). The solder metal comprises an external section which protrudes from the first surface of the work piece, forming a "bump" shape. Figure 1H and column 4, lines 70-75.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 in view of Amano and Locke to provide the metal filling method by immersing the work piece in molten metal as suggested by Schneble with an expectation of desirable metal filling results, because '875 in view of Amano and Locke provides filling metal in a hole after the hole area has an oxide layer followed by a metal layer; and Schneble provides a known way to fill a hole with a metal layer on the inside with a metal fill. It would further have been obvious '875 in view of Amano, Locke and Schneble to further remove the work piece from the molten metal bath and solidify the molten metal, in order to have a desirable treated substrate for use, because '875 in view of Amano, Locke and Schneble teaches to dip the article in molten metal, and demonstrates the result of a plated and filled article, indicating that the article must be removed from the molten metal bath for final use and furthermore the molten metal would solidify after removed from the bath, because it was no longer heated.

Response to Arguments

10. Applicant's arguments with respect to claims 9-11, 13-18 and 20-22 have been considered but are moot in view of the new ground(s) of rejection.

The new references to Japan 4-206875 and Amano are used as discussed in the rejections above as to the newly claimed features.

Conclusion

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Katherine A. Bareford whose telephone number is (571) 272-1413. The examiner can normally be reached on M-F(6:00-3:30) First Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy H. Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Katherine A. Bareford/
Primary Examiner, Art Unit 1792